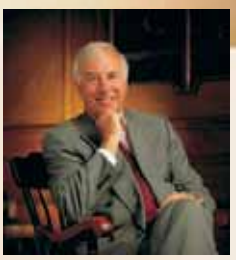
PROTECTING MARYLAND'S

COMPETITIVE EDGE

An Action Summit Hosted by the University of Maryland



A CALL TO ACTION

Over the past several years, America has watched other nations take vigorous competitive strides by investing heavily in science and technology. The United States has not adequately responded to this challenge, endangering our nation's dominance in these fields. Part of the answer lies in an increased federal commitment to education and basic research. But it is also necessary for the public and private sectors in Maryland to respond, as well.

Last year, a National Academies committee issued a report, *Rising Above the Gathering Storm*, making the case for federal investment and proposing specific action steps. Since then, legislation based on the report's recommendations has been introduced in Congress and President Bush has proposed an American Competitiveness Initiative.

That is an important start, and we remain hopeful that these initiatives will bear fruit. But federal action alone will not get the job done. Much of what needs fixing will require state and grassroots action. It is especially important for all of us in the state of Maryland to improve the "pipeline" of talent to make sure we have world-class scientists, engineers, mathematicians and teachers.

There are many steps we can take to improve K–12 achievement in math and science, stimulate basic research and innovation, and fill the science and technology pipeline. Beyond this, the state can further distinguish itself by taking steps to strengthen the overall math and science capabilities of all students—even if they do not plan scientific careers. Science thrives amid an appreciation of its principles and methods and a strong foundation in math and science will pay dividends for all students—no matter their field of study.

To transform these opportunities into action, the University of Maryland and 19 co-sponsoring organizations held a statewide summit, on April 26, 2006, to stimulate a coordinated grassroots response to these competitiveness issues. The driving force behind Protecting Maryland's Competitive Edge was to serve as a catalyst, the nexus where important interactions would take place.

State government cannot do it alone; neither can the private sector, school systems or universities. The key to quick and meaningful action lies in collaborations and coordination among these sectors. Many of the linkages already exist, but we also need to look for logical new partnerships to help get the job done.

Our main task was to identify issues and opportunities, identify partnerships and collaborations; then develop a series of short- and long-term recommendations that move the State forward.

In working panel sessions, participants—including high-level leaders from the various sectors, people who can get things done—talked about the problems and suggested some specific follow-up actions. You will find some of these briefly summarized by the moderators who led the discussions.

"The driving force behind Protecting Maryland's Competitive Edge was to serve as a catalyst, the nexus where important interactions would take place."

Among other things, they reported significant connections among the six panels, which suggested that the problems are systemic—high among them is the need to kindle an interest and fascination in students as early as kindergarten about careers in science, technology, engineering, and math (STEM). There were also calls for some creative recruiting of teachers. Several participants spoke of the need for more collaboration, perhaps a task force that could implement one of the suggestions—and I could not agree more. We encourage those leaders to get involved.

If we are to make the most of this unique opportunity, we must think seriously and realistically about the followup. The Summit was just the beginning (a start at the top to get to the bottom).

Maryland is the first to face the state and regional challenges directly. At this summit, and in the following months, Maryland has an opportunity to create and share a vision for how America can control its destiny in this highly competitive arena.

C. D. Mote, Jr.

President, University of Maryland
Glenn L. Martin Institute Professor of Engineering

About the Recommendations...

The following panel recommendations represent only some of the ideas generated by participants at the April 26, 2006 summit, *Protecting Maryland's Competitive Edge*. The approximately 250 stakeholders who took part in the panel sessions came to brainstorm and offered many ideas and approaches. These highlights suggest some of the most practical starting points for action.

The key word here is "action." Maryland is the first state to host this kind of high-level meeting since the National Academies' report, *Rising Above the Gathering Storm*, came out last year. This summit has generated genuine excitement among Maryland's business leaders, educators, engineers and scientists, as well as the national organizations that focus on competitiveness issues. Summit participants recognized the need for Maryland to pursue grassroots actions to strengthen its own competitiveness edge and the important role that all stakeholders—especially major research universities—can play. Other states are likely to follow with efforts on their own behalf.

Improving K–12 Science and Mathematics Education

Richard Steinke, deputy state superintendent, Maryland State Department of Education

There is a need to change perceptions about science–technology–engineering–mathematics (STEM). A recent survey found that 84 percent of U.S. middle school students would rather clean their rooms, take out the garbage or go to the dentist than do math homework. Obviously we have a lot to do. Some participants suggested an organized information campaign, and that may be a start. Others spoke of more fundamental changes.

From kindergarten, children need more opportunities to experience how science, technology and math are part of their everyday world. Yet, we heard again that the scale of solutions is too small for the scale of the challenges. While we have many excellent schools and teachers, we do not have enough. It will take more to reach children who have never imagined a serious future in science, technology, engineering and mathematics—a talent pool we cannot afford to ignore.

Panel 1 Recommendations

1. Identify model programs, which offer government and corporate retirees certification for K-12 teaching credentials (IBM model) and market those programs to government and corporate leaders.
2. Develop a group to follow up.
3. Approach the Boy Scouts and Girl Scouts in Maryland to develop a "Science and Math" merit badge.

Higher Education—Recruitment and Retention of the Best and Brightest Students, Scientists and Engineers

Steven Knapp, provost and senior vice president for academic affairs, Johns Hopkins University

How do we plug the leaky pipeline of talented students and teachers? Students are losing interest, and the education pipeline leaks potential talent at every point from the lower grades into higher education. One way to address this problem is to focus on the entire spectrum from "K through Gray." For example, we can find an untapped resource in the retiring personnel from government and industrial labs around the state who might teach science–technology–engineering–math (STEM).

Marketing to students and parents is a priority, responding to negative cultural signals that STEM fields are "boring," "nerdy," "too difficult" or lacking in opportunities. Also, we need to improve science teaching, making it more inspiring and connect science and engineering to real-world experiences. Higher education can help by developing more effective techniques for teaching in the lower grades. Communication with industry can help us identify the skills needed in today's world and tomorrow's.

Panel 2 Recommendations

1. Hold a statewide Maryland STEM recruiting job fair for college seniors with representatives from government and industry.
2. Develop a model outreach program that all Maryland universities can use to more actively recruit science and engineering students from Maryland high schools.
3. Develop a high-level action group to identify relevant issues and resources, and then lead implementation of recommendations.

Commitment to Long-Term Basic Research

William Jeffrey, director of the National Institute of Standards and Technology

In basic research, Maryland starts from a position of strength because of the presence of federal government laboratories, as well as strong research universities and a highly trained workforce. By many measures, Maryland ranks at the top of the nation in federal R&D investment on a relative scale. Private industrial R&D spending, however, is significantly below the federal support levels. Leveraging the presence of the federal government assets to benefit the future of the state's enterprises is a high priority.

Panel 3 Recommendations

1. Form a task force to identify Maryland's research strengths and needs and then to propose strategies to fill the gaps. It is critically important to have top-notch university research facilities to help attract and accommodate more federal and private dollars. The goal is to be more facile at leveraging Maryland's research strengths. A task force might undertake an assessment of the physical infrastructure for basic

research in the states it considers aspirational peers and determine what Maryland's universities need to do to achieve a commensurate infrastructure.
2. Hold a STEM roundtable for Maryland state legislators to identify the benefits of a math—and science–based economy in the state.
3. Create a Maryland Competitive Edge Task Force comprised of university, business and industry leaders to propose steps that will promote Maryland competitiveness in basic research across state and federal government, business and education.
4. Ask the governor to proclaim Maryland as an "Innovation Hot Spot" or "Informatics Corridor" to promote support of a math and science-based economy.

Incentives for Innovation, Entrepreneurship and Technology Transfer

Christopher C. Foster, deputy secretary, Maryland Department of Business and Economic Development

It is clear that many of these problems are systemic. Workforce development is Maryland's number one issue. For example, the lack of women in the STEM workforce really hurts Maryland's competitiveness. Nearly 80 percent of graduates who leave the state for their first job are not coming back. We have to do a lot more to make sure they get jobs here.

On the incentive side, the state needs to change mindsets that are stuck in the old economy. Basic tax credits, for example, do not work for young innovative companies operating at a net loss for many years; they do not yet owe taxes. Instead of thinking about a government that is just business-friendly, we have to be innovation-friendly.

Panel 4 Recommendations

1. Arrange for as many Maryland-based federal labs as possible to get the "Entrepreneurial Boot Camp" series from MTECH (U. of Maryland).
2. Maryland should undertake a systematic review of state regulations and laws that may provide barriers for innovation and new business location and growth.
3. Develop a group in Maryland (university, industry, government) to specifically identify major high-technology corporations to move all or part of their operations to the state.

Fostering Emerging Technologies—Energy

James Harkins, director, Maryland Environmental Service

We must take a holistic approach, perhaps by forming a consortium on energy that involves government, the business sector and higher education. That three-legged stool can lead to a better working relationship. With a close partnership, we can develop an energy strategy for the state and make sure we are accessing all the available federal research dollars in this area. There is a lot of money out there for innovative programs.

Panel 5 Recommendations

1. Form a Maryland Energy Alliance (university, industry, government) to pool research and programmatic ideas for Maryland citizens to conserve energy.
2. Develop a Maryland public awareness campaign to encourage energy conservation.
3. Identify existing energy conservation model programs and expand them (e.g., BP Solar Program).

Job Creation and Workforce Development

Gino Gemignani, chair, Governor's Workforce Investment Board; senior vice president, Whiting-Turner Construction

There is no apparent center of gravity for this movement in Maryland. The state needs a clear focal point with a broad enough depth of field that we can see short—and long-term.

We must examine Maryland's untapped labor pool. Approximately 900,000 people are not in the workforce in a meaningful way. We tend to think of them as people with very severe problems, but some problems are more manageable, like language. We have a number of scientists and engineers separated from a wonderful job only by a language barrier.

Also, business really needs to get more involved in education—not simply sending a check, but getting into the classroom to inspire young people early on. We are not just preparing students to work in Maryland. We operate in a global economy, and students need to be trained in that perspective from the very beginning.

Panel 6 Recommendations

1. State should support a public service campaign aimed at middle and high school students about careers in science and technology and the skills for the future.
2. Create a statewide "Competitive Edge Scholarship" program that is supported by the state, businesses and federal laboratories. Such a fund will provide scholarships for students entering science, mathematics and engineering at the college level, with a "guaranteed job opportunity" upon graduation. Businesses and the federal labs could participate by giving preference to those graduating from Maryland universities (a Maryland first recruitment policy); the state could participate by directing merit scholarship money preferentially into these fields.
3. Create a working group (university, business, and government) to advance the recommendations and explore logical next steps.

PANEL PARTICIPANTS

Panel 1: Improving K–12 Science and Mathematics Education

Moderator: *Richard J. Steinke*, Deputy State Superintendent for Instruction and Academic Acceleration, Maryland State Department of Education

Panelists: *Joe A. Hairston*, Superintendent, Baltimore County Public Schools; *Katharine Oliver*, Assistant State Superintendent, Division of Technology and Adult Learning; *James F. Pitts*, Corporate Vice President and President, Northrop Grumman Electronic Systems

Panel 2: Higher Education—Recruitment and Retention of the Best and Brightest Students, Scientists and Engineers

Moderator: *Steven Knapp*, Provost and Senior Vice President for Academic Affairs, Johns Hopkins University

Panelists: *Judy E. Ackerman*, Vice President and Provost, Montgomery College, Rockville Campus, *Calvin Burnett*, Secretary, Maryland Higher Education Commission; *Ann G. Wylie*, Assistant President and Chief of Staff, Professor of Geology, University of Maryland

Panel 3: Commitment to Long-Term Basic Research

Moderator: *William A. Jeffrey*, Director, National Institute of Standards and Technology (NIST)

Panelists: *Evan Jones*, Chairman and CEO, Digene; *Aris Melissaratos*, Secretary, Maryland Department of Business and Economic Development; *Theodore O. Poehler*, Vice Provost for Research, Johns Hopkins University

Panel 4: Incentives for Innovation, Entrepreneurship and Technology Transfer

Moderator: *Christopher C. Foster*, Deputy Secretary, Maryland Department of Business and Economic Development

Panelists: *Julie Coons*, President, Tech Council of Maryland; *Henry "Pete" Linsert, Jr.*, Chairman and Chief Executive Officer, Martek Biosciences Corporation; *Nariman Farvardin*, Dean, A. James Clark School of Engineering, University of Maryland; *Renée M. Winsky*, Interim Executive Director, Maryland Technology Development Corporation (TEDCO)

Panel 5: Fostering Emerging Technologies—Energy

Moderator: *James M. Harkins*, Director, Maryland Environmental Service.

Panelists: *Bryan Eichhorn*, Professor, Department of Chemistry and Biochemistry, University of Maryland; *Benjamin H. Wu*, Esq., Assistant Secretary, Business Development, Capital Region, Maryland Department of Business and Economic Development; *William C. Poulin*, Director of Products North America, BP Solar

Panel 6: Job Creation and Workforce Development

Moderator: *Gino J. Gemignani, Jr.*, Senior Vice President, The Whiting-Turner Contracting Company Chairman, Governor's Workforce Investment Board.

Panelists: *James D. Fielder*, Secretary, Maryland Department of Labor, Licensing and Regulation; *Barbara Krumsiek*, President and CEO, Calvert Group, Ltd.; Chair-Elect, Greater Washington Board of Trade; *Edward Montgomery*, Dean, College of Behavioral and Social Sciences, University of Maryland

Co-Sponsors

- Baltimore/Washington Corridor Chamber of Commerce (BWCC)
- Federal Laboratory Consortium for Technology Transfer Mid-Atlantic Region (FLC)
- Greater Baltimore Committee (GBC)
- Greater Baltimore Technology Council
- Greater Washington Board of Trade
- Johns Hopkins University
- Maryland Association of Community Colleges (MDACC)
- Maryland Business Roundtable for Education
- Maryland Chamber of Commerce
- Maryland Department of Business and Economic Development (DBED)
- Maryland Economic Development Association (MEDA)
- Maryland Independent College and University Association (MICUA)
- Maryland State Department of Education (MSDE)
- Maryland Technology Development Corporation (TEDCO)
- Prince George's Black Chamber of Commerce
- Regional Manufacturing Institute (RMI)
- Research Parks Maryland (RPM)
- Tech Council of Maryland
- University System of Maryland (USM)

For more details about Protecting Maryland's Competitive Edge, please contact:
The University of Maryland Office of University Communications,
301.405.4621, or visit **www.competitive-edge.umd.edu**

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A SNAPSHOT OF SCIENCE & TECHNOLOGY IN THE STATE OF MARYLAND

Maryland ranks high nationally in areas that support a strong and competitive knowledge-based economy. In part this reflects a highly-trained workforce and an extensive concentration of research facilities, including major federal laboratories. For example, the state of Maryland is:

- No. 1 nationally in percentage of professional and technical workers in the workforce;
- No. 2 nationally in federal research and development spending.

On some other measures the state does not rank as high. This snapshot offers a brief picture of the state's scientific-technological strengths and vulnerabilities.

OVERALL POSITION

Maryland ranks No. 4 among the states on a *Science and Technology Index* created by the Milken Institute. On five separate indices, Maryland scored near the top, with an average rating of 78.19.

1	Massachusetts	84.35
2	California	78.86
3	Colorado	78.77
4	Maryland	78.19
5	Virginia	72.27

The report notes: "Maryland's most poignant strengths are in the life sciences and communications technology, two sectors with extremely bright long-term prospects, and where it has some of the best and deepest talent in the nation."

Source: "State Technology and Science Index," Milken Institute, March 2004

WORKFORCE

- **Percentage of professional and technical workers in the workforce (2002):** Maryland ranks No. 1 among the states (24 %)
- **Doctoral scientists & engineers (2001):** 2nd highest concentration of all states; No. 2 in employed Ph.D. scientists and engineers per 100,000 employed workers (938.5)
- **Graduate and professional degrees/age 25+ (2000):** No. 2 among the states (13.4%)

Source: Maryland Department of Business and Economic Development

RESEARCH AND DEVELOPMENT

- **Federal R&D obligations (2002):** Maryland ranks No. 2 among the states ($7.2 billion); No. 2 among states in federal R&D per capita
- **Academically-based federal research:** More than $1 billion annually performed by the University System of Maryland and Johns Hopkins University

In part this federal spending reflects the proximity to federal research centers (e.g., National Institute of Standards and Technology, National Institutes of Health, Johns Hopkins University-Applied Physics Laboratory, University of Maryland Center for Advanced Study of Language) as well as to federal customers (e.g., National Security Agency, NASA Goddard Space Flight Center, etc.)

Source: Maryland Department of Business and Economic Development

- **Research and development as a percentage of gross state product:** Maryland ranks No. 9 among the states ($10.1 million of $213 million in 2003)
- **Federal R&D as percentage of all research spending:** Maryland ranks No. 9 among the states (37%); federal=41% of all R&D performed in Md., Va., and D.C.; 56% of all federal R&D spent in Ca., N.M., Md., Va., and D.C.
- **R&D performed by industry:** No. 13 among the states

"R&D performance is geographically concentrated in the United States. Over 50% of U.S. R&D is performed in only seven states. … One way to control for the size of each state's economy is to measure each state's R&D level as a percentage of its gross state product (GSP)… Some of the states with the highest R&D to GSP ratios include Michigan, home to the major auto manufacturers; Massachusetts, home to a number of large research universities and a thriving high-technology industry; and Maryland, home to the National Institutes

of Health."

Source: NSF Science and Engineering Indicators 2006

Note: The Milken Institute report says Maryland's high rank in federal research funding reflects the ring of U.S. laboratories located near Washington, D.C. It concludes that this is both a strength and a potential vulnerability should federal spending priorities change.

HUMAN CAPITAL INVESTMENT

Higher Education

National

- **Science and engineering doctorates awarded (2002):** Maryland ranked No. 11 among the states (638); 33% were in the life sciences, 20% in engineering, and 20% in social sciences.
- **Science/Technology degrees awarded (2000-2001):** No. 15 among the states (2,004 degrees)
- **Graduate students attending S&E doctorate-granting institutions (2002):** No. 12 among the states (12,204)

Source: National Science Foundation; University of Maryland analysis

- **College freshmen earning bachelor's degree within six years:** No. 2 among all states (64%)

Source: Center for American Progress report and Institute for America's Future; The State We're In: An Education Report Card for the State of Maryland

- **Student aid expenditures per full-time undergraduates:** state of Maryland ranks in the second quartile nationally

Source: NSF Science and Technology Indicators 2006

International

- **Science and engineering degrees (percent of total undergraduate degrees):** Japan, 66%; China, 59%; Germany, 36%; U.S. 32%;
- **Engineering degrees:** U.S., 5%; China, 50%

Source: National Academy of Engineering

K-12 STEM performance (Science-Technology-Engineering-Math)

National Educational Proficiency Testing

- **4th grade math:** No. 21 nationwide (38%; 2004) in the percent at or above proficiency level; No. 31 (21%) below proficiency
- **8th grade math:** No. 23 nationwide (30%; 2005) in the percent at or above proficiency; No. 34 (34%; 2005) in the percent below proficiency
- **4th grade science:** No. 23 nationwide (24%; 2000) in the percent at or above proficiency level; No. 28 (39%; 2000) in the percent below proficiency
- **8th grad science:** No. 21 nationwide (27%; 2000) in the percent at or above proficiency level; No. 23 (43%; 2000) in the percent below proficiency

Source: Kids Count and U.S. Department of Education

- **High school graduates academically ready for college:** No. 8 nationwide (39%)
- **High school graduation rate:** No. 17 nationally (77%)

Source: Center for American Progress report and Institute for America's Future; The State We're In: An Education Report Card for the State of Maryland

- **Students taking advanced placement calculus exam (2004):** 12% (national average= 7%)

Source: U.S. Department of Education

- **Teen high school dropouts** (2004): No. 20 nationwide (7%)

Source: Kids Count and U.S. Department of Education

International

"In a recent international test involving mathematical understanding, U.S. students finished in 27th place among participating nations. About two-thirds of students studying chemistry and physics in U.S. high schools are taught by teachers with no major or certificate in the subject. In the case of math taught in grades five through 12, the fraction is one-half."

Source: National Academy of Engineering

ENTREPRENEURIAL ENVIRONMENT

- **Patents awarded per 1,000 individuals in science and engineering occupations (2003):** Maryland ranks in the third quartile nationally; California led nation (22% of all patents)
- **Venture capital disbursed per $1,000 of gross state product (2003):** Maryland ranks in the first quartile nationally; No. 1 California had more than four times as much venture capital spending as Maryland
- **High-technology share of all business establish ments (2002):** Maryland ranks in the first quartile nationally; Maryland's percentage comparable to Massachusetts and higher than California and Florida (the states with the biggest growth in high tech industries)
- **Average Small Business Innovation Research (SBIR) program award dollars per $1 million of gross state product (2001–03):** Maryland ranks in the first quartile nationally; more than 2.5 times greater than California's but nearly half as great as Massachusetts

Source: NSF Science and Technology Indicators 2006